Pest and Disease Control: Strategies for Sustainable Plant Protection

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Institution: Research Institute of Organic Agriculture, FiBL

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Schweizerische Eidgenossenschaft
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Learning objectives

Describe the hierarchical structure of the plant **protection strategy pyramid** in organic farming.

Explain the role of **prevention and ecosystem-based** approaches in pest management.

Evaluate **crop protection strategies** based on organic farming principles through a few examples.

Explain the purpose and function of national **input lists** in organic farming.

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Scene

01

Overview of the plant protection pyramid in organic farming



How do plant diseases develop?



Pictures: FiBL

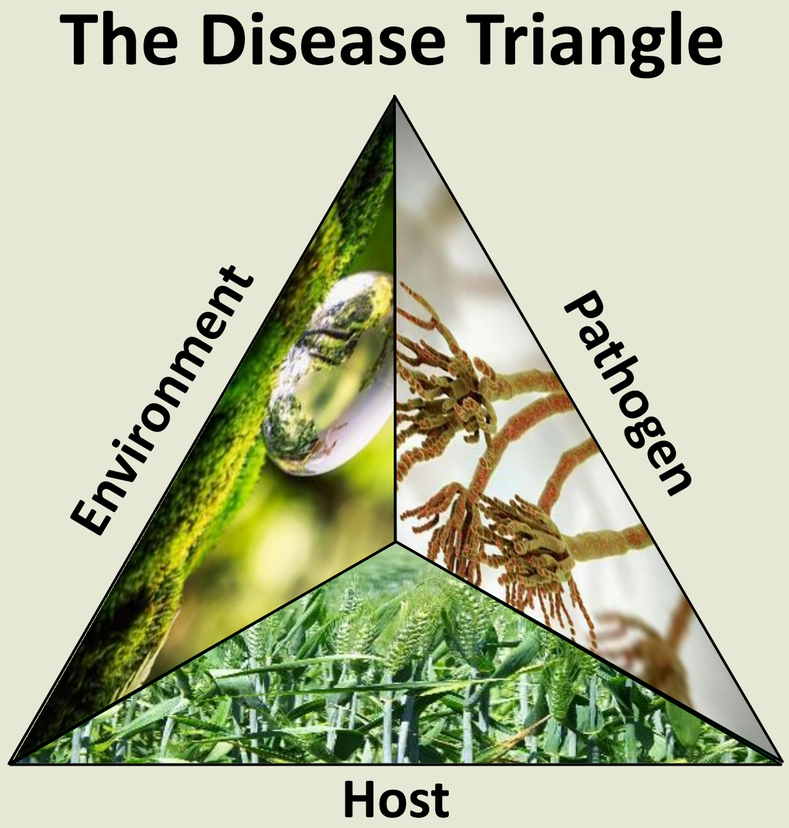
Interplay between host plant, pathogen and environmental factors

Host: e.g. variety, age, genetic homogeneity

Pathogen: e.g. virulence of strain, quantity and type of inoculum, presence of vectors

Environment: e.g. temperature, humidity, daylight

- The time of infection is very important and often limited to a few occasions.
- Permanent structures (e.g., spores, sclerotia) allow pathogens to survive unfavourable environmental conditions.

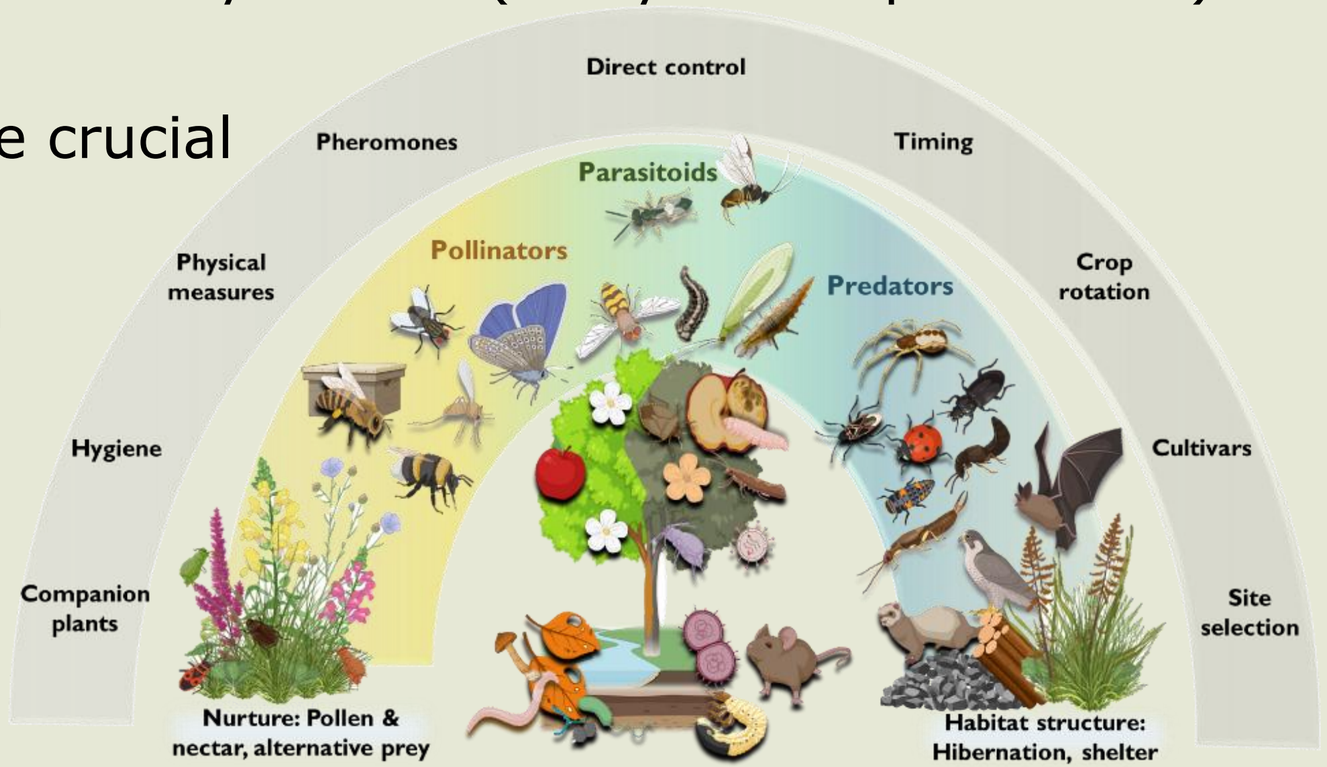


How to regulate plant diseases in organic farming?

- Direct plant protection is very limited (no synthetic pesticides!)
- Indirect measures are crucial

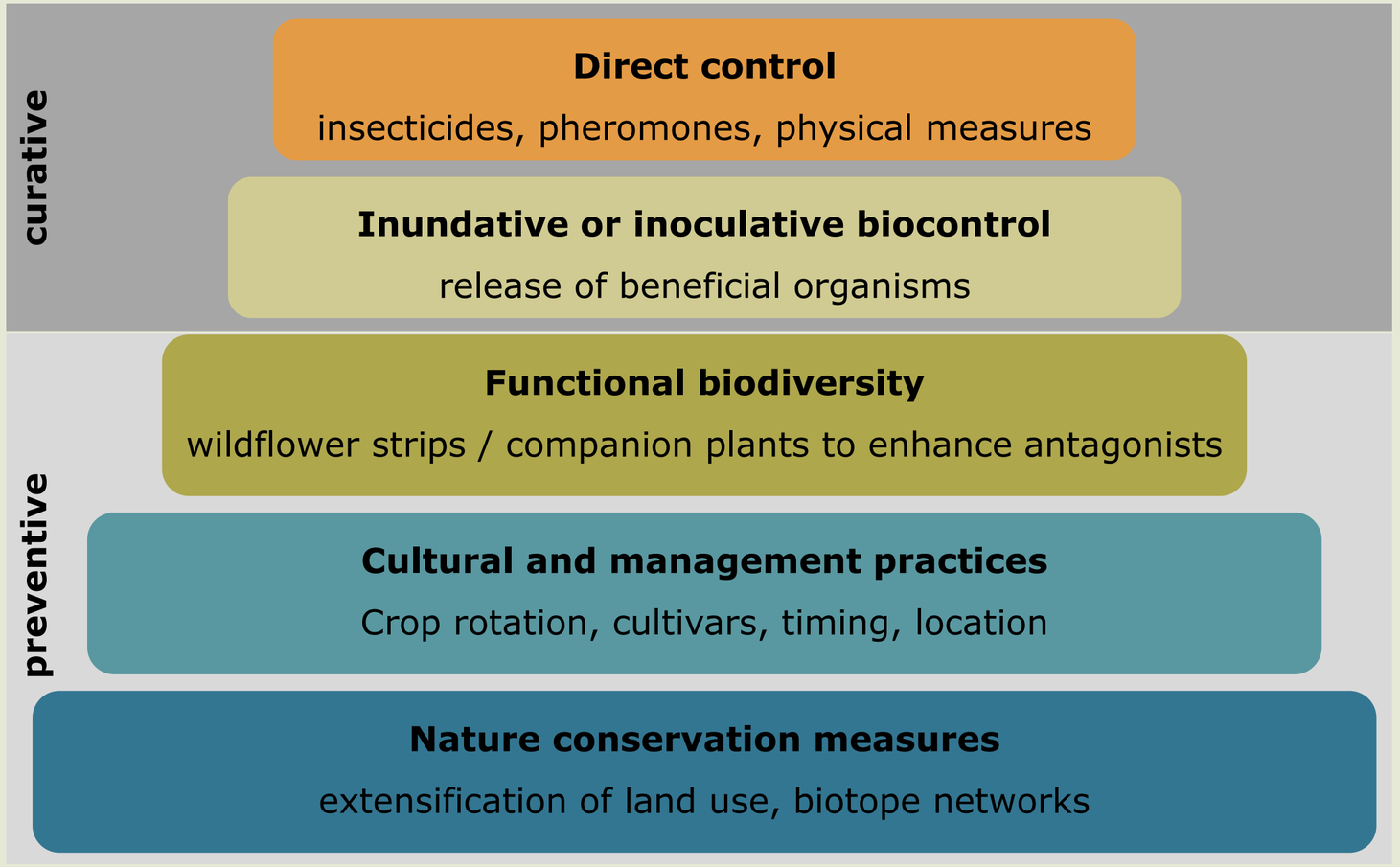
  ➢ Crop protection starts before plants are growing in the field

  ➢ As soon as diseases are established, they are difficult to control



Cahenzli, FIBL

The plant protection pyramid in organic farming



Modified from: https://www.fibl.org/fileadmin/documents/de/news/2019/daniel-2019-07-02-pflanzenschutz.pdf

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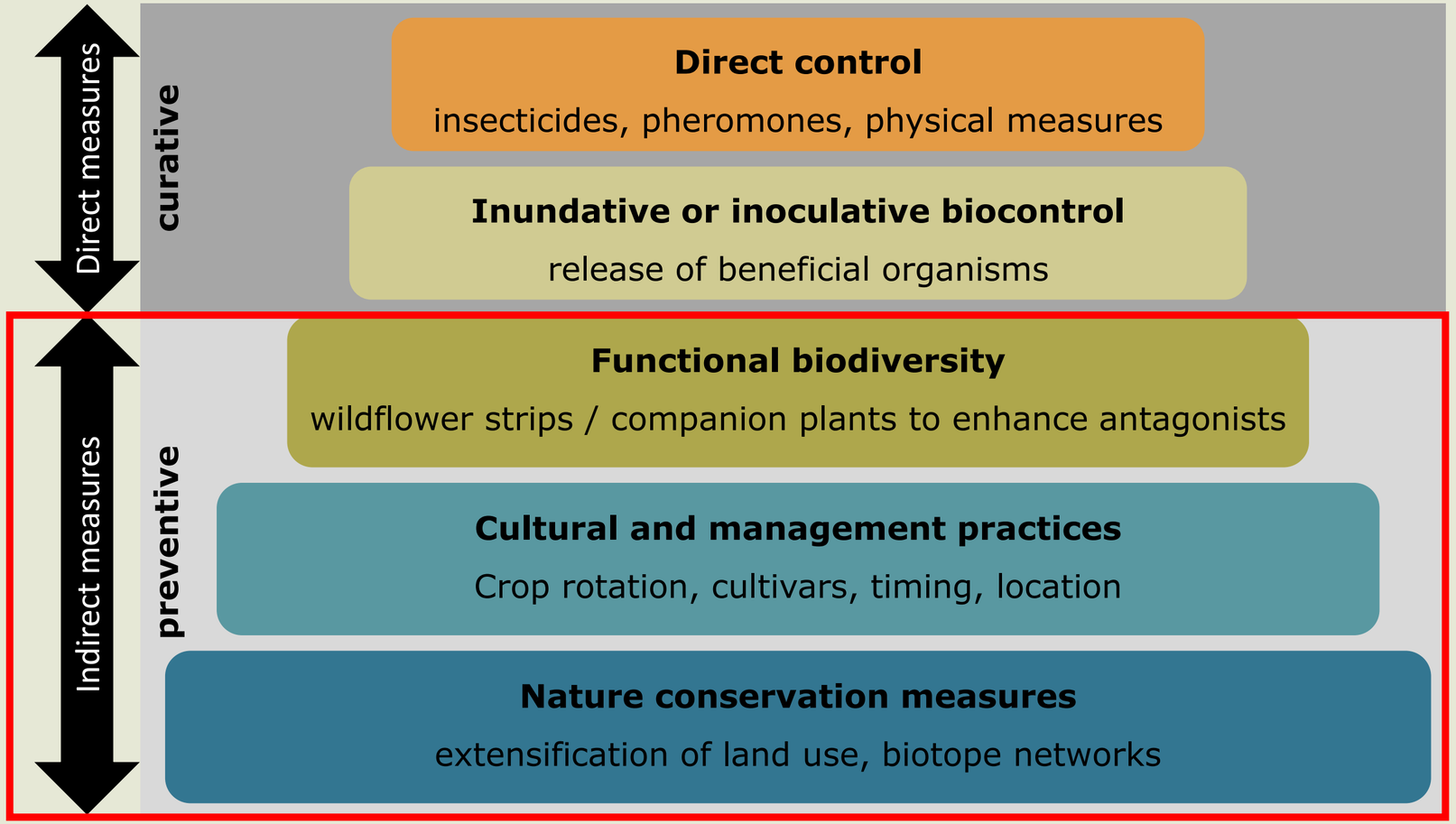
Scene

02

Importance of prevention and ecosystem-based pest control



Crop protection in organic farming is built on prevention



Modified from: https://www.fibl.org/fileadmin/documents/de/news/2019/daniel-2019-07-02-pflanzenschutz.pdf

Extensification and diversification of the landscape





Hubert Schürmann, Biodiversität im Regal – Ein Praxisbeispiel aus der Schweiz, 10.10.2022



https://www.tiroler-schutzgebiete.at/schutzgebiete/naturschutzgebiete/





- It is an important part of biological plant protection
- Proven general reduction of pests – rarely sufficient as a standalone measure
- Little effect on plant diseases

Selection of resistant varieties: examples from pome fruits and grapevines





Blauacher



Otava



Marssonina (*Diplocarpon coronariae*)

Grapevines Downy mildew (*Plasmopara viticola*)

Variety	Average amount of Cu used by OF in CH	In % of maximally allowed amounts
European grape varieties	2.9 kg/ha/y	73% / 96%
Robust(«PiWi») varieties	0.5 kg/ha/y	13%

Speiser et al. 2015. Agrarforschung Schweiz 6(4) pp. 160-165

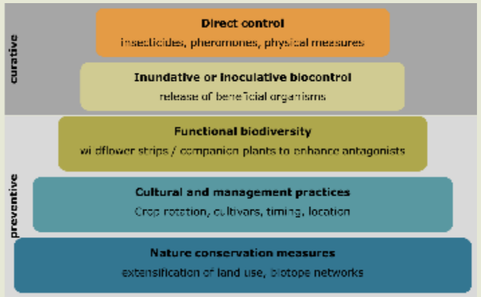
New copper limit by Bio Suisse: 3 kg/ha/year across the entire farm



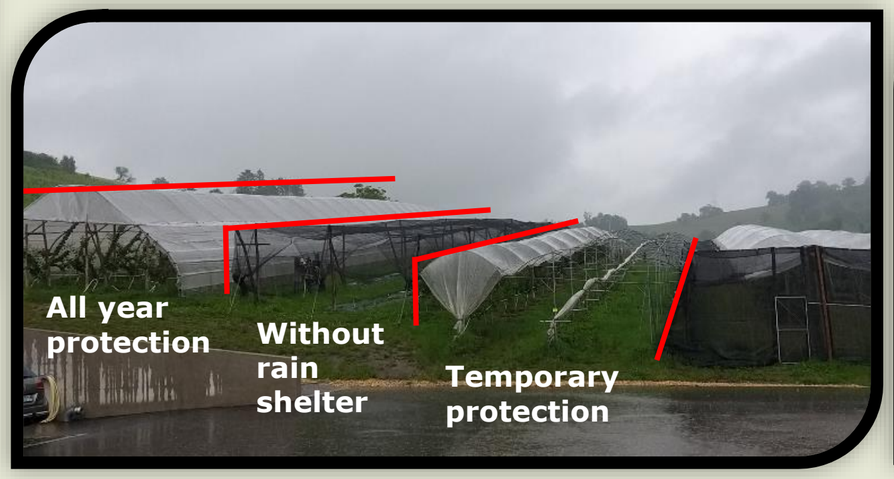
Pictures: FiBL

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Smart Moisture Management in Horticulture: Innovative Rain Shelters, Net Systems & photovoltaics







Pictures: FiBL



Mobile, weather-controlled rain shelter: e.g. prototype development at FiBL



Agrivoltaics for pear orchards – pv magazine International (pv-magazine.com)

Study impact on:

- Pests and diseases
- Beneficials/Biodiversity
- Plant physiology

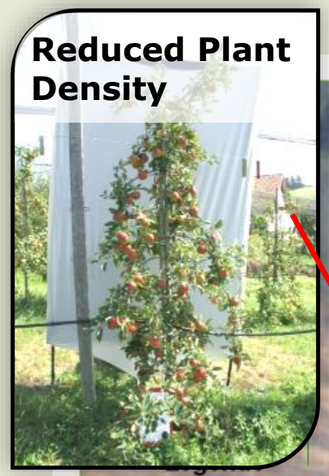


Field trial «Sustainable Fruit System (SFS)»





Resistant varieties
Topaz, Ariwa



Reduced Plant Density



All pictures: FiBL

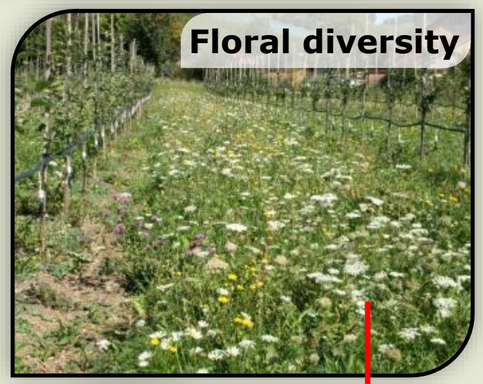
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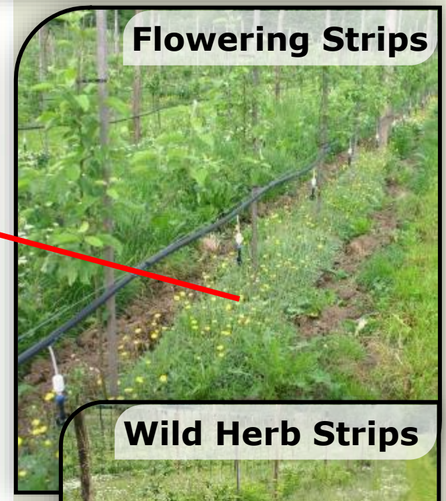




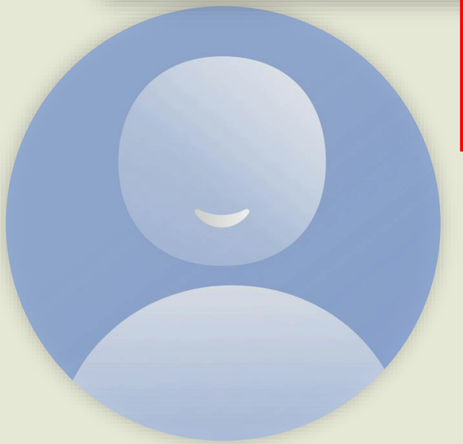








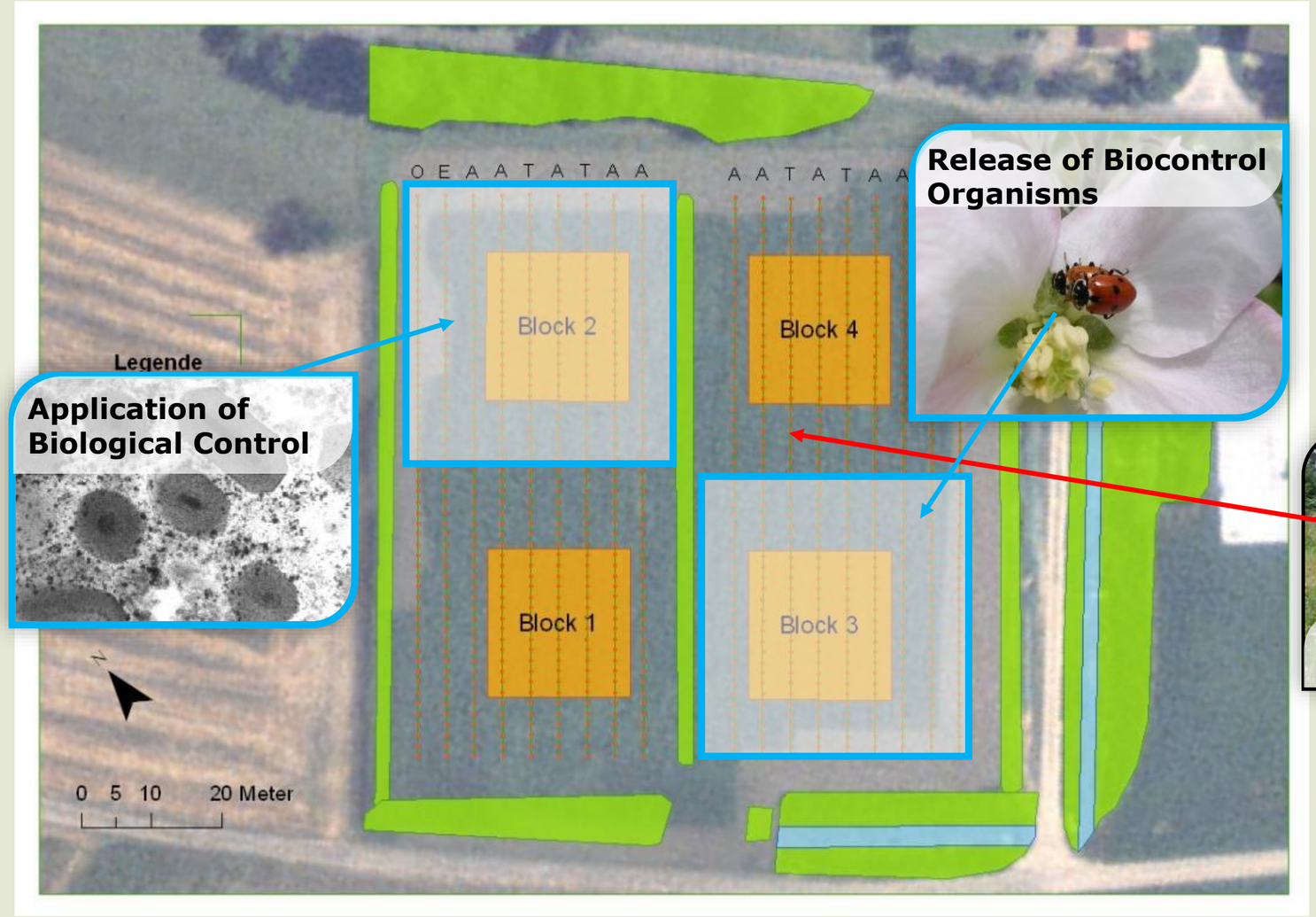




All pictures: FiBL

Field trial «Sustainable Fruit System (SFS)»



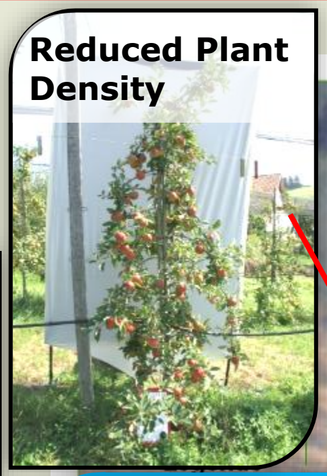


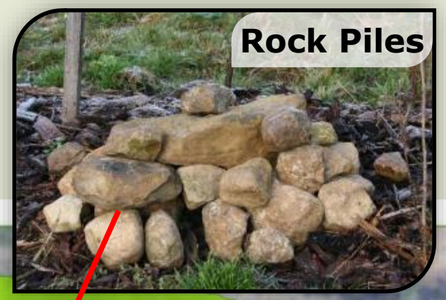
All pictures: FiBL

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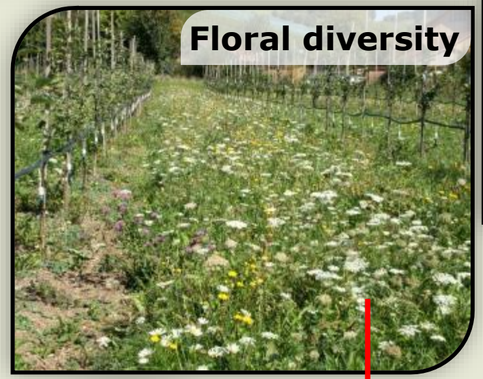



Nest


Reduced Plant Density


Rock Piles


Hedges


Floral diversity


Application of Biological Control

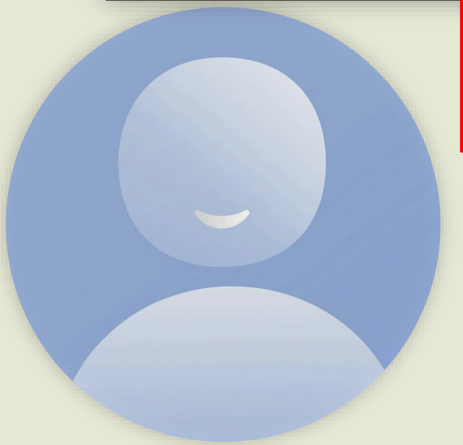

Release of Biocontrol Organisms


Flowering Strips


Resistant varieties Topaz, Ariwa


Wild Herb Strips


Compost-Driven Nitrogen Fertilization



All pictures: FiBL

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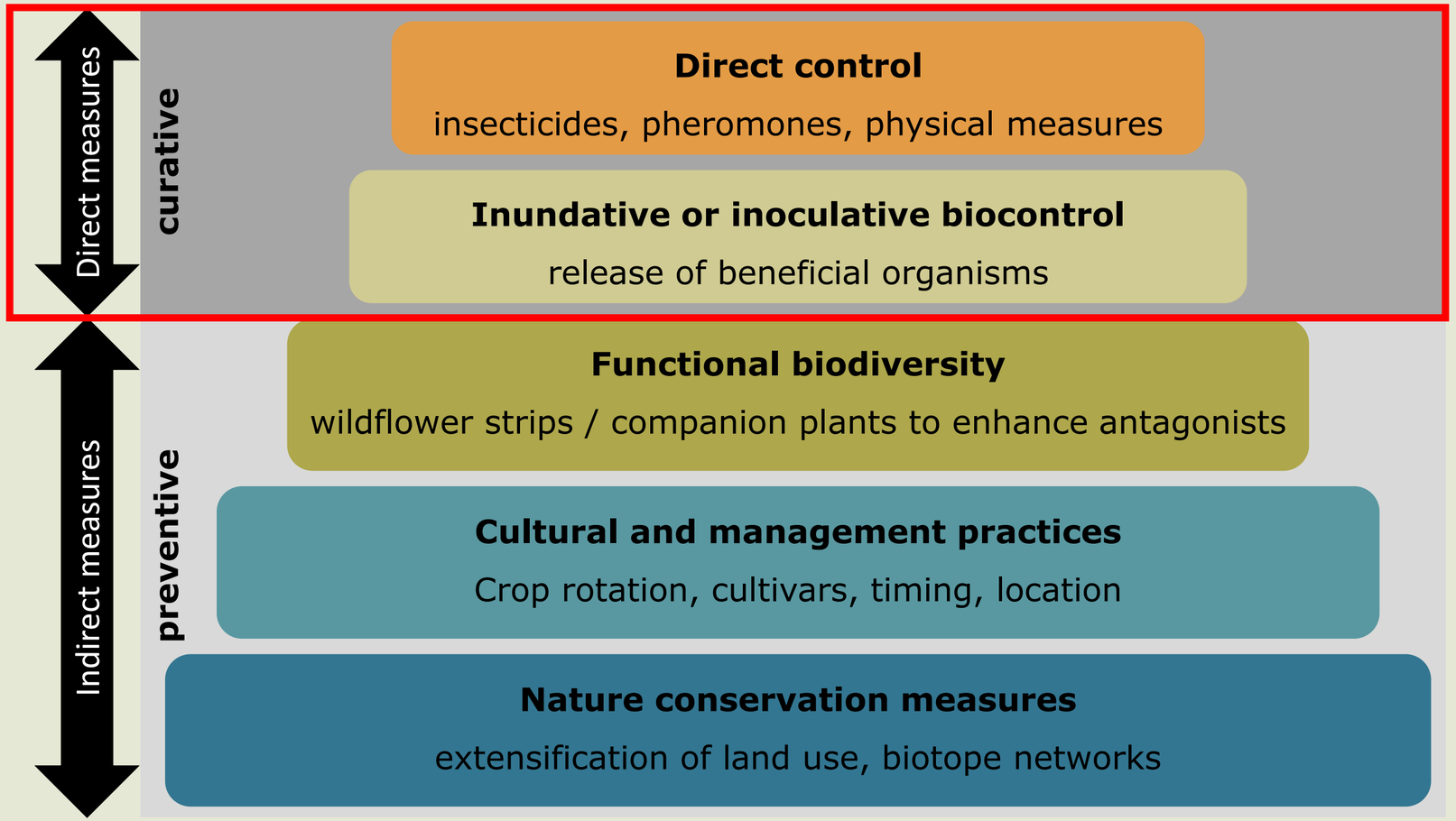
Scene

03

Examples of crop protection aligned with organic principles

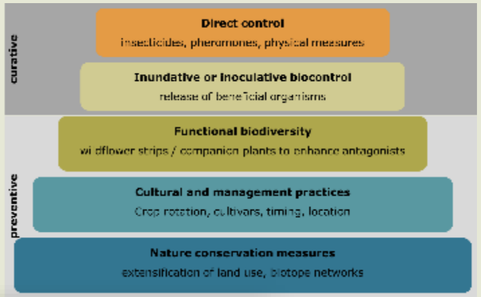


Crop protection in organic farming is built on prevention



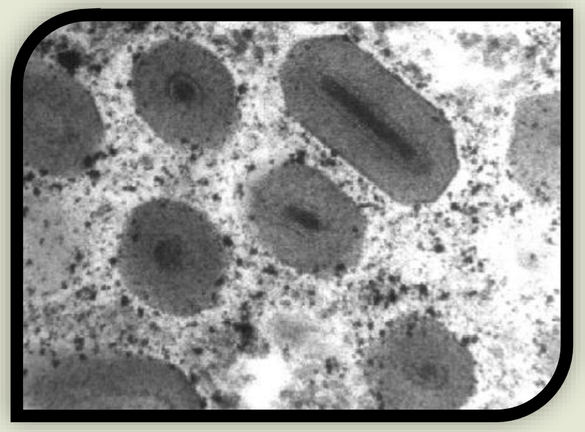


Direct measures: Biocontrol



Application of natural antagonists

- Against plant diseases:
  - Mostly **Micro**organisms
    - Bacteria (e.g. *Bacillus, Pseudomonas*)
    - Fungi (e.g. *Trichoderma*)
- Pests:
  - Additionally: many **Macro**organisms
    - Entomopathogenic nematodes
    - parasites (e.g. parasitic wasps)
    - predators (predatory mites, ladybirds)

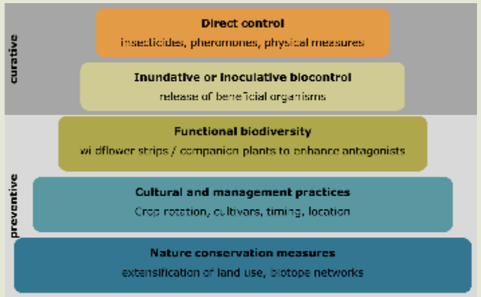


https://www.abim.ch/fileadmin/abim/documents/presentations2015/6_Zingg_ABIM_2015.pdf

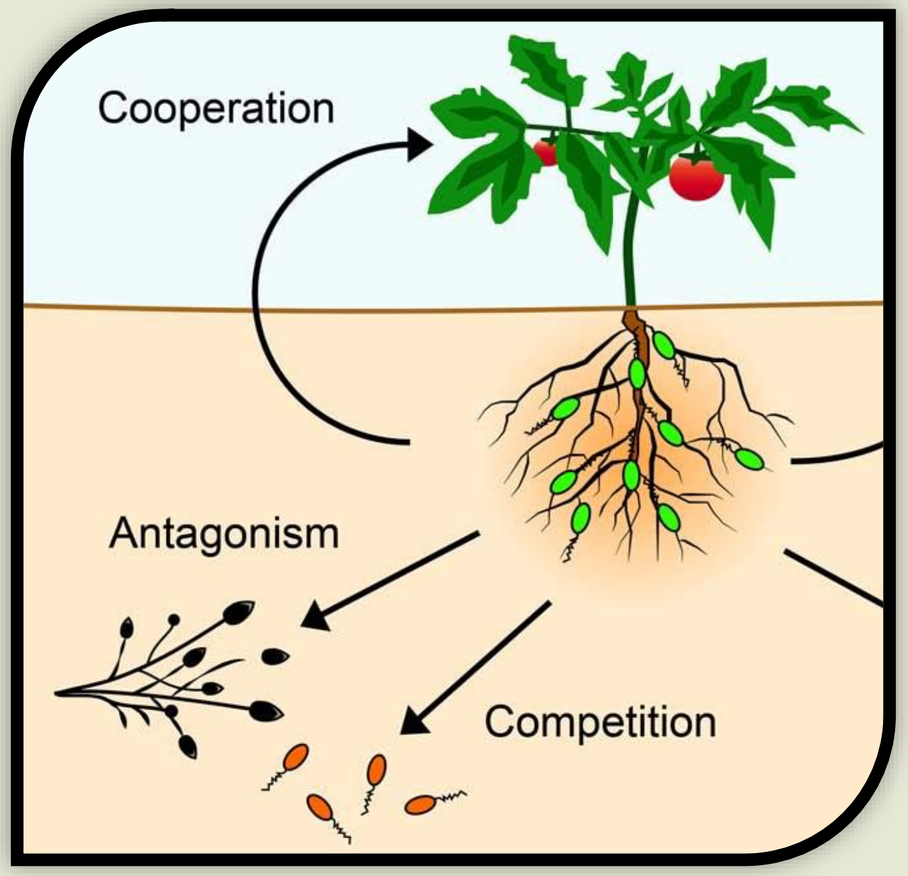


Pictures: FiBL

Mechanisms of biocontrol



- Competition for nutrients and space
- Antagonism (antimicrobial compounds)
- Hyperparasitism (Parasitation of pathogens)
- Induced resistance (Activation of the plant immune system)



Kupferschmied et al., 2013

Examples of authorized biocontrol organisms



www.betriebsmittelliste.ch

Product name	Organism	Activity against (example)
Prestop	*Gliocladium catenulatum*	Pathogenic soil fungi
Contans	*Coniothyrium minitans*	Sclerotinia
Amylo-X, FZB24, Serenade, Taegro	*Bacillus amyloliquefaciens*	in various vegetables against grey rot, powdery mildew, sclerotinia...
Deposan	*Pseudomonas sp.*	potato
Botector	*Aureobasidium pullulans*	Grey rot
Avengelus, Bio Force, Bactiva, NuTrinum, Remedier, RhizoSan, ….	*Trichoderma sp.*	Auxiliaries and additives



Direct plant protection: Pesticides



- Despite its “unpopular” level, it’s crucial in certain situations
- Only natural substances:
  - Mineral origin
  - Plant extracts
  - Microbial metabolites
- No synthetic pesticides, no herbicides
- Few fungicidal actives are authorized for organic farming
- Allowed active ingredients → national organic input lists



Pictures: FiBL

Terminology

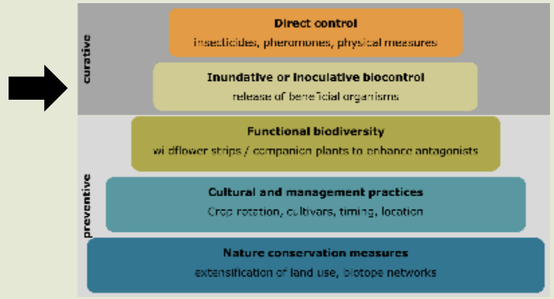


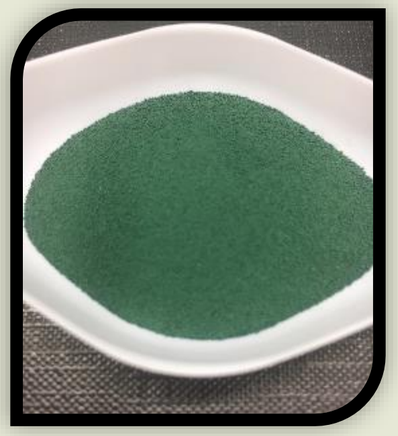
- Active substance:
  - The main ingredient in a product that causes the desired effect of the product
- Plant protection product (PPP)
  - Contains the **active substance** + **additives** to allow for improved handling
  - The same active substance might be contained in several PPP



https://www.biocontrol.ch/de-ch/madex-twin

Approved Substances for Organic Plant Disease Control (Switzerland)







Origin	Active ingredient	Products	Mode of action
Mineral	Copper (different molecules)	23 allowed	fungicide
	Sulphur, lime sulphur	App. 20 products	fungicide
	Acidified clay minerals	e.g. Mycosin, Agrolem	fungicide
	Potassium bicarbonate	App. 21 products	fungicide
Plant, animal	Fennel oil	e.g. Fenicur	fungicide
	Laminarin (from algae)	Vacciplant	Inducer of resistance
	Cos-OGA (from crab shells and pectins from citrus)	Auralis, FytoSave	Inducer of resistance

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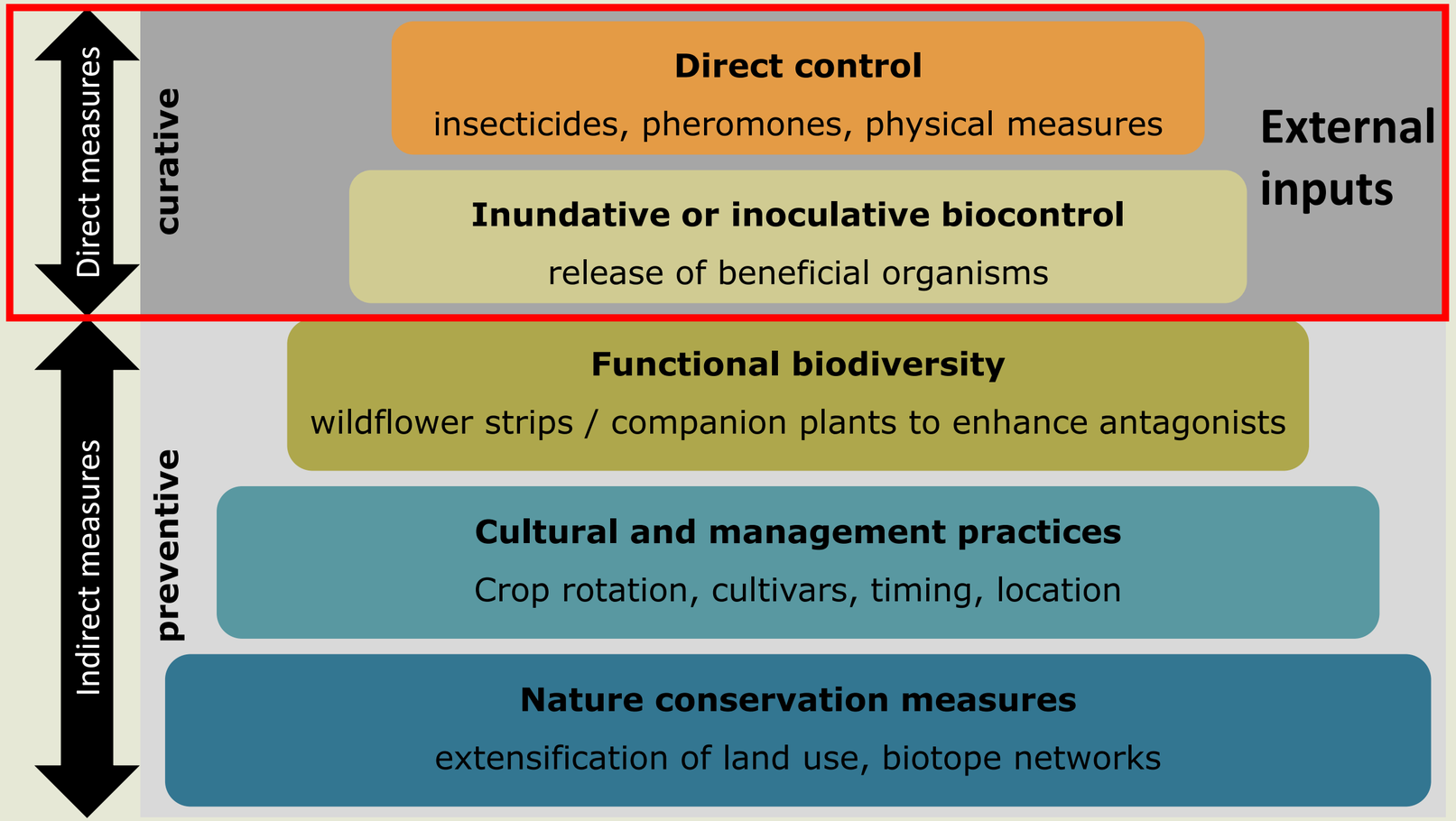
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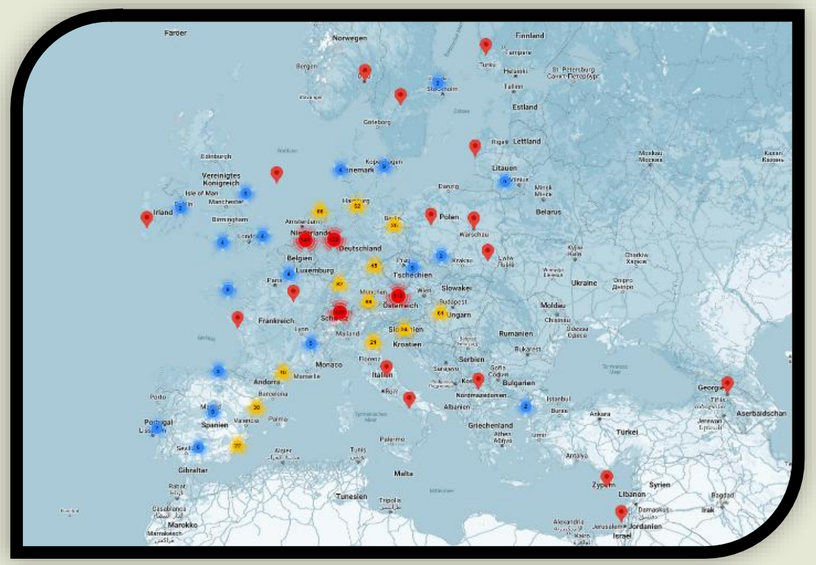
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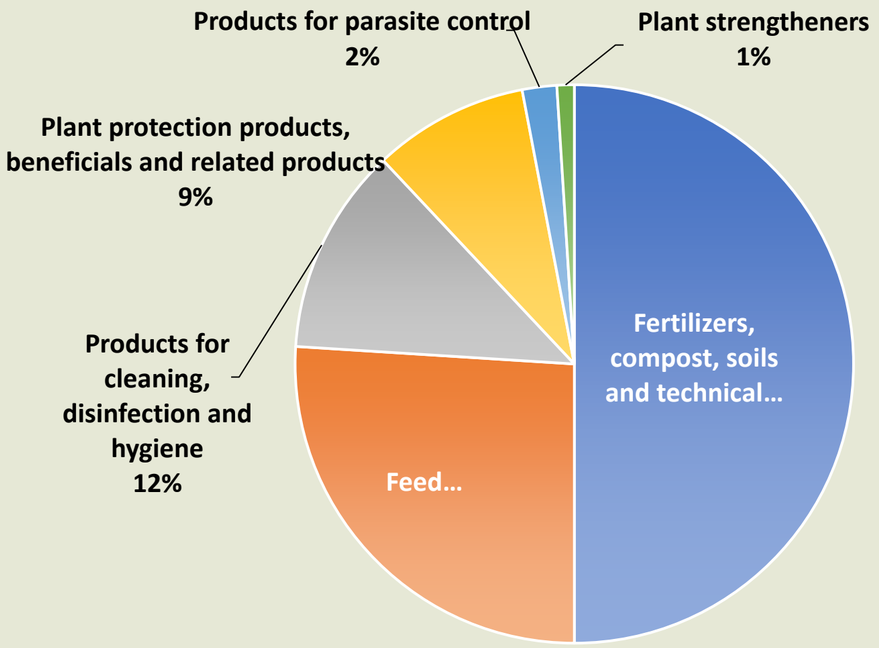
Role of national input lists in organic farming

The objectives in organic production is to reduce the use of external inputs



The European Input List





https://www.inputs.eu

>10 000 products

- Compilation of national lists
- It is a political forum, it has no legal validity for the farmers, national lists remain the reference
- The farmers use the national lists to check whether an input is permitted or not in organic farming
- It’s free of charge for farmers



The National Input Lists

- Switzerland
- The Netherlands
- Italy
- Sweden

FiBL Schweiz

- Germany

FiBL Deutschland

- Austria
- Croatia
- Hungary

EASY-CERT services
Betriebsmittelbewertung



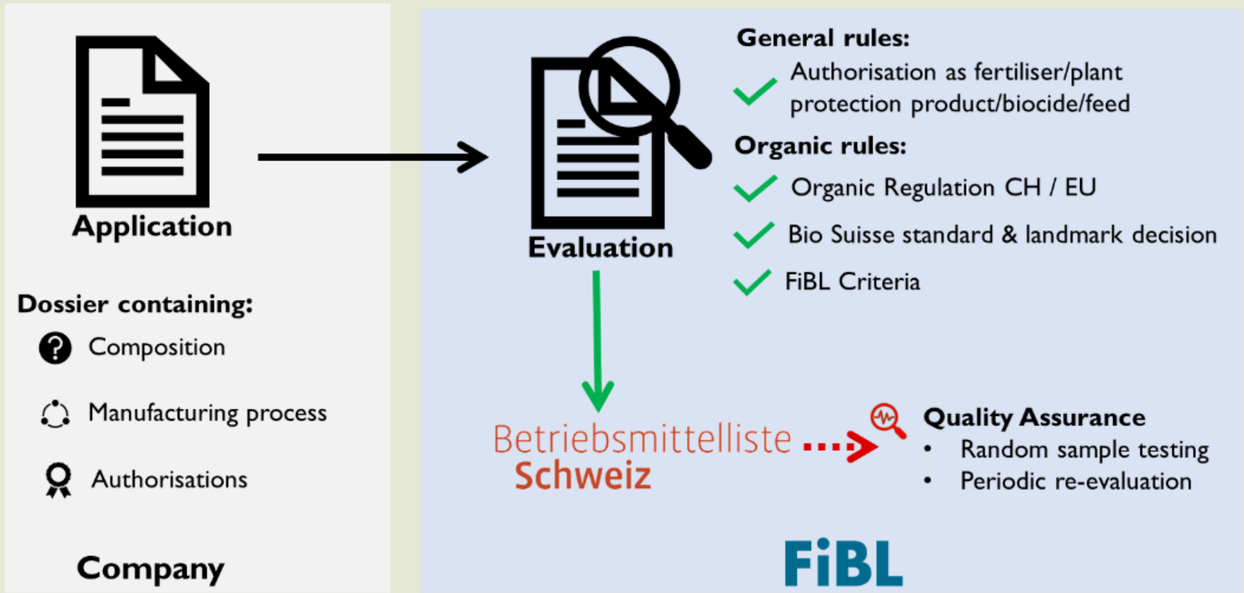
FiBL – Praxispublikationen



- Public registers of inputs legally used by certified organic farmers
- Used by farmers and certifiers to verify compliance with organic regulations
- Created to give more transparency since is based on public criteria

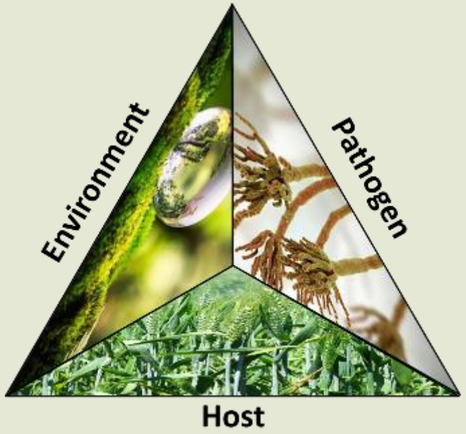
Criteria for Plant Protection Products (PPP)

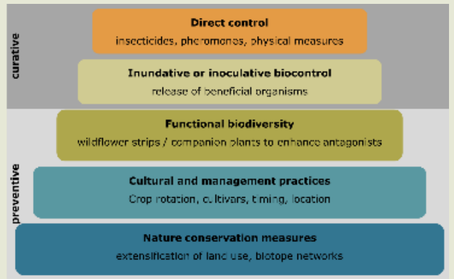
- Based on EU Organic Regulation (EU 2021/1165)
- Active substances must be authorized for organic use
- Inputs must be GMO-free





Take home messages





- Consider specificity, even above efficacy
- Identification & understanding of pathogens is crucial
- Broad range of strategies applied (crop protection pyramid)
- Most strategies = preventive/indirect strategies
- Plant protection products are only used on top if necessary
- Only a limited range of plant protection products with low risk is allowed
- Free public registers of inputs; used by farmers and certifiers to verify compliance and increase transparency





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Thank you.
We appreciate your interest.

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